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# Note

## Benzopyrans: Part 39†—2-Amino-3-iminomethyl-1-benzopyran-4-ones do not function as heterodienes

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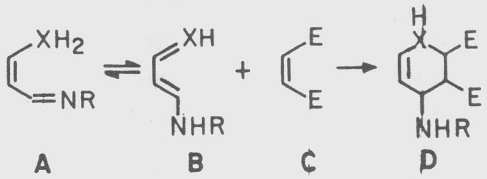
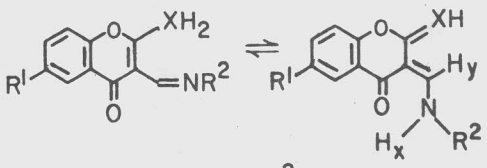
The hydrazone **3** ($R^1$=H and Me) in refluxing chloroform is converted by dimethyl acetylenedicarboxylate (DMAD) to the aminonitrile **12** whereas **3** and **4** when refluxed in DMF with either DMAD or *N*-phenylmaleimide undergo self-condensation to the diazocine **12** and pyranopyrimidine **14**, respectively instead of giving any [4+2]-cycloadduct.

β-Methyl-α,β-unsaturated imine (**A**, X=CH) undergoes through its enamine tautomer **B**, [4+2]cyclo-addition with a dienophile like **C** (**E**=electron withdrawing group) to give the cycloadduct **D** (Scheme I)[1]. 2-Methyl-3-iminomethyl-1-benzo-pyran-4-ones **1** and **2** incorporating the diene system **A** indeed give through their enamine tautomers **5** and **6** with *N*-phenylmaleimide (NPMI) the all carbon Diels-Alder adducts which have been converted to the xanthone system[2]. The title 1-benzopyran-4-ones (chromones) like **3** and **4** containing the azadiene system **A** (X=N) are nitrogen analogues of **1** and **2**, respectively. So these are likely to behave as 1-azadienes **7** and **8**, akin to *o*-quinone methide imines, in unergoing hetero Diels-Alder cycloaddition[3] with NPMI and dimethyl acetylenedicarboxylate (DMAD) to give respectively the adducts **9** and **10** which may be converted into 4-azaxanthone system[4-6]. That this contention was belied and the substrates **3** and **4** gave other products is reported in this note.

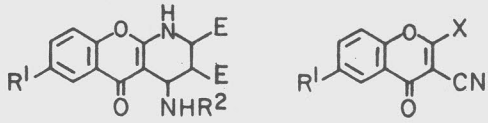
Unlike the initial 1,2-addition of phenyl-



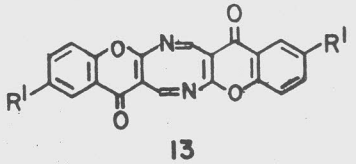
**Scheme I**



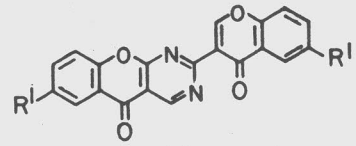
| | X | $R^2$ | |
|---|---|---|---|
| 1 : | CH | $NMe_2$ | : 5 |
| 2 : | CH | $C_6H_4Me$-*p* | : 6 |
| 3 : | N | $NMe_2$ | : 7 |
| 4 : | N | $C_6H_4Me$-*p* | : 8 |



9 : EE = CONPhCO  11 : X = H
10 : E = $CO_2Me$  12 : X = $NH_2$



13



14

For
1 – 14 : a, $R^1$ = H ; b, $R^1$ = Me

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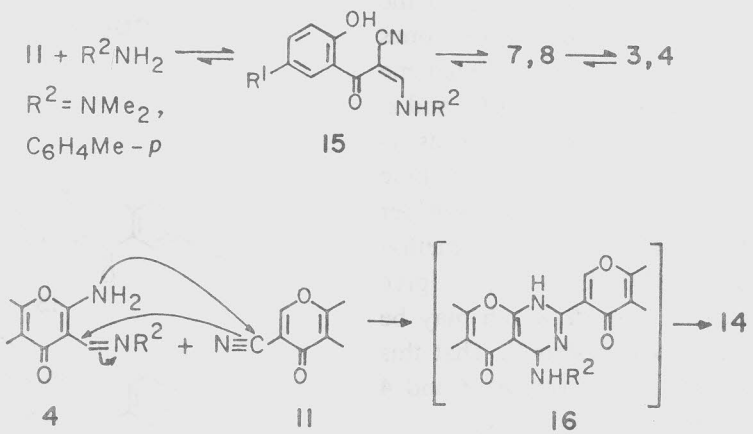
hydrazine to the nitrile function of chromone-3-nitrile **11** in ethanolic medium[6], refluxing benzene induces its initial 1,4-addition producing ultimately the phenylhydrazone derivative of 2-amino- 4 -oxo- 4*H*-1-benzopyran-3-carboxaldehyde[7]. Cognate preparation of the 2-aminochromone derivatives **7** and **8** by reacting the nitrile **11** with 1,1-dimethylhydrazine and *p*-toluidine respectively in boiling benzene was feasible. Here the nucleophile $R^2NH_2$ undergoes 1,4-addition to **11** with concomitant opening of the pyran ring to afford the acrylonitrile derivative **12**; cyclisation of the latter to **13** followed by a hydrogen shift forming **3** and **4** (Scheme II). Refluxing an ethanolic solution of 1,1-dimethylhydrazine with an equivalent amount of either the appropriate 2-amino-3-formylchromone[4] or 4-oxo-4*H*-1-benzopyran-3-aldoxime[4] also resulted in hydrazone **3**. IR stretching frequencies at *ca* 3200 and 3060 $cm^{-1}$ indicate the presence of amino group in **3** but the amino protons are not detected in its $^1H$ NMR spectrum. Mass spectrum, however, was compatible with the assigned structure **3** (*vide* Experimental). The IR spectrum of **4** in KBr pellet shows an intense peak at 2210 $cm^{-1}$ attributable to the presence of a cyano group, and $^1H$ NMR spectra indicates the compound to exist solely in its enamine tautomeric form **8** in its chloroform solution, the spectral pattern for its =CHNHAr grouping resembling that exhibited by the anilinomethylene grouping in the 1:2-adduct of 3-formylchromone and aniline[8]. So it is evident that compound **4**, depending on the conditions, can also exist solely or partially in its two other tautomeric forms **8** and **12**.

As the aminochromone **4** remains exclusively in the cisoid azabutadiene form **8** in chloroform solution, this substrate as well as its analogue **3** was first treated with DMAD and NPMI separately in refluxing chloroform. Under this reaction condition DMAD brought about elimination of dimethylamine[9] from the hydrazone **3** to afford the aminonitrile **12** whereas both the substrates **3** and **4** remained unreactive towards NPMI. When the above substrates were heated with either of the aforesaid dienophiles under reflux in dimethylformamide (DMF), **3** underwent self-condensation to the diazocine **13**[10] and **4** to the pyranopyrimidine **14**[11], the formation of any of the cycloadducts **9** and **10** being completely excluded. In refluxing DMF even the dedimethylamination of **3** by DMAD was predominated over by self-condensation of the former. Formation of **13** involves nucleophilic 1,2-addition of $NH_2$ group of one molecule of **3** to the $CH{=}NNMe_2$ group of its second molecule and subsequent elimination of two molecules of dimethylhydrazine. When heated under reflux in DMF, the Schiff base **4** reverses back through the tautomeric forms **8** and **15** ($R^2{=}C_6H_4Me$-*p*) to its precursor nitrile **11** (Scheme




**Scheme II**

II); the aminochromone **4**, then condenses with the nitrile function of **11** and the resultant intermediate **16** by elimination of *p*-toluidine affords the pyrimidine **14** (Scheme II).

## Experimental Section

The reported melting points are uncorrected. All the new compounds gave satisfactory C, H, N analyses. Light petroleum refers to the fraction, b.p. 40-60°.

**2-Amino-3-(*N, N*-dimethylhydrazonomethyl)-chromone 3: Method A.** A mixture of the nitrile **11** (10 mmoles) and 1,1-dimethylhydrazine (1.1 g, ~0.75 mL, 10 mmoles) dissolved in dry benzene (50 mL) was heated under reflux for 4 hr. The reaction mixture was cooled, the deposited solid filtered off and crystallised from chloroform-light petroleum to afford the chromone **3**.

**3a**: Yield 62%, m.p. 216°; IR (KBr): 3200, 3062, ($NH_2$), 1662 (CO), 1607 (C=N) $cm^{-1}$; $^1H$ NMR: δ 8.24 (1H, dd, *J*=8, 2Hz, H-5), 8.08 (1H, s, CH=N), 7.64 -7.24 (3H, m, H-6, 7, 8) and 2.86 (6H, s, $NMe_2$); MS: m/z 231 ($M^+$, 18%), 187 (M-$NMe_2$, 100), 161 (187-CN, 11), 121 ($HOC_6H_4CO$, 44).

**3b**: Yield 69%, m.p. 212°; IR (KBr): 3222, 3050 ($NH_2$), 1638 (CO); $^1H$ NMR: δ 8.16 (1H, s, CH=N), 8.06 (1H, d, *J*~2Hz, H-5), 7.36 (1H, dd, *J*=8, 2Hz, H-7), 7.14 (1H, d, *J*=8 Hz, H-8), 2.86 (6H, s, $NMe_2$) and 2.42 (3H, s, Me-6); MS: m/z 245 ($M^+$, 40%), 201 (M-$NMe_2$, 100), 135 [$Me(OH)C_6H_3CO$, 30].

**Method B.** The appropriate 2-amino-3-formylchromone or 4-oxo-4*H*-1-benzopyran-3-aldoxime (10 mmoles) together with 1,1-dimethylhydrazine (10 mmoles) was refluxed in ethanol (100 mL) for 6 hr. The brownish yellow product deposited after concentration of the reaction mixture and subsequent cooling was collected by filtration and crystallised from chloroform-light petroleum to afford the hydrazone **3** identical with that obtained by method A. The yield of **3** by this method was around 50% from 2-amino-3-formylchromone and 60% from the aforementioned aldoxime.

**2-Amino-3-(*p*-tolyliminomethyl)chromone 4.** An equivalent mixture of **11** and *p*-toluidine was heated under reflux in benzene for 4 hr and then cooled when the title chromone **4** precipitated out. The compound **4a** (70%) melted at 211° and **4b** (74%) had m.p. 210°; IR (KBr): 3220 (NH), 3175 (OH), 2210 (CN), 1660 (CO) [for the tautomeric form **15** ($R^2$=$C_6H_4Me$-*p*)]; $^1H$ NMR ($CDCl_3$, 100 MHz): δ 12.44 (1H, d, *J*=13 Hz, $H_X$), 11.24 (1H, brs, =NH), 8.20 (1H, d, *J*=2Hz, H-5), 8.02 (1H, d, *J*=13 Hz, $H_Y$), 7.52-6.88 (6H, m, other ArH), 2.24 (3H, s, Me) and 2.20 (3H, s, Me) [compatible with the tautomeric form **8b**].

**Treatment of the hydrazone 3 and Schiff base 4 with DMAD and NPMI: Method A.** A mixture of **3** (1 mmole) and DMAD (0.1 mL) was heated under reflux in chloroform (50 mL) for 4-6 hr. The deposited solid was filtered and washed with chloroform to yield 2-amino-4-oxo-4*H*-1-benzopyran-3-carbonitrile **12** in 76-80% yield. The nitrile **12a** (76%) had m.p. 308° (decomp) (lit.[4], m.p. 310-11° decomp) and **12b** had m.p. >280°; IR (KBr): 3310, 3130 ($NH_2$), 2220 (CN), 1670 (CO), 1620 (C=C) $cm^{-1}$; $^1H$ NMR (DMSO-$d_6$, 300 MHz): δ 8.81 (2H, brs, exchangeable, $NH_2$), 7.67 (1H, ill split d, H-5), 7.46 (1H, ill split dd, *J*=8.2 Hz, H-7), 7.26 (1H, d, *J*=8.2 Hz, H-8) and 2.33 (3H, s, Me).

After treatment of **3** with NPMI and that of **4** with DMAD as well as with NPMI under similar conditions, the substrates **3** and **4** were recovered (~80%) unchanged.

**Method B.** An equivalent (10 mmoles) mixture of **3** and either DMAD or NPMI on being refluxed in DMF (25 mL) for 8-10 hr followed by usual work-up of the reaction mixture afforded 8,16-dioxo-8*H*,16*H*-diazocino[2,3-*b*:6,7-*b'*]bis[1]benzopyran **13** in 40-50% yield. The diazocine **13a**, m.p. 220-223° (lit.[10], m.p. 210°) and **13b**, m.p. 230° (decomp) (lit.[10], m.p. 215°) were identical (IR, $^1H$ NMR and mass spectra) with the respective authentic samples[10]. The Schiff base **4** on similar treatment with either NPMI or DMAD afforded 5-oxo-5*H*-2-(4-oxo-4*H*-1- benzopyraan-3-yl)[1]benzopyrano[2,3-*d*]pyrimidine **14** in 70-75% yield. The product **14a**, m.p. 245° (lit.[11], m.p. 240°) and **14b**, m.p. 290° (lit.[11], m.p. 297°) were identical (IR, $^1H$ NMR and mass spectra) with the respective authentic samples[11].

## Acknowledgement

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